UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/712,563	11/13/2003	Joseph Phillip Bigus	ROC920020170US1	8807

30206 7590 03/18/2010

IBM CORPORATION
ROCHESTER IP LAW DEPT. 917
3605 HIGHWAY 52 NORTH
ROCHESTER, MN 55901-7829

EXAMINER	
FERNANDEZ RIVAS, OMAR F	
ART UNIT	**PAPER NUMBER**
2129	
NOTIFICATION DATE	**DELIVERY MODE**
03/18/2010	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

rociplaw@us.ibm.com

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte JOSEPH PHILLIP BIGUS
and DONALD ALLEN SCHLOSNAGLE

Appeal 2009-002962
Application 10/712,563[1]
Technology Center 2100

Decided: March 16, 2010

Before JOHN A. JEFFERY, JAMES D. THOMAS, and LEE E. BARRETT, *Administrative Patent Judges*.

BARRETT, *Administrative Patent Judge*.

DECISION ON APPEAL

This is a decision on appeal under 35 U.S.C. § 134(a) from the final rejection of claims 1-30. We have jurisdiction pursuant to 35 U.S.C. § 6(b).

We reverse.

---

[1] Filed November 13, 2003, titled "Method, Apparatus, and Program Product for Matching Multivariate Data to Fuzzy Sets." The real party in interest is International Business Machines Corporation.

STATEMENT OF THE CASE

The invention

The invention relates to recognizing patterns in multivariate data using Fuzzy Logic. Spec. 3, ¶ [0006].

Multivariate data analysis is characterized as the study of how two or more factors are related to one another. One example of multivariate data analysis is the study of how "things change over time." Measurements of things that change over time are referred to in the Specification as time variant or time series data. Thus, the study of time variant data is a form of multivariate data analysis. *Id.* at ¶ [0002]. Measurements can be collected from sensors and used to make more or less "real" time adjustments to the system being monitored. *Id.* at ¶ [0003]. An example is measuring oxygen in an automobile exhaust system to determine whether the fuel/air mixture is lean or rich and then adjusting the fuel/air mixture to the right amount. *Id.* at ¶ [0004].

Appellants state that what is difficult is identifying patterns within time series data that permit application of well-known solutions. Prior art methods using dynamic curve matching, deformable Markov model templates, and piecewise matching of subcurves are complex mathematically and there is no easy way to describe the shape of the curves using a natural language (such as English). *Id.* at ¶ [0005].

The invention uses fuzzy logic to describe a curve. For example, in the automobile example, a mass air flow (MAF) sensor takes measurements of the air moving through a conduit at time intervals and the amount of air

changes over time, forming a curve of time series data (a curve of air versus time). The curve value (value from MAF sensor) may be represented by data having one of 256 values ranging from 0 to 1. This curve is compared to standard curves also represented by 256 values ranging from 0 to 1, where the curves are characterized as: monotonically increasing, monotonically decreasing, inflected up, inflected down, and flat. In fuzzy logic terms, these standard curves are represented by the fuzzy variables: rising, falling, variant up, variant down, and constant. The data curve is compared with each standard curve to determine a degree of similarity, or using fuzzy logic terminology, a degree of membership in each fuzzy set, and the degree of similarity is represented as an output curve. *Id.* at ¶ [0024]. The output curves are evaluated to determine a "greatest match" curve and the fuzzy rules are then executed using the results of the match. *Id.* at ¶ [0029].

Illustrative claim

Claim 1 is reproduced below for illustration:

1. An apparatus, said apparatus comprising:

a controller, and

a curve matching mechanism that executes under the direction of said controller, said curve matching mechanism receiving curve data as an input, said curve data comprising a plurality of data points representing a curve, said curve matching mechanism using Fuzzy Logic to describe said curve represented by said curve data and to thereby create curve data description information, said curve data description information then being available to said controller.

The references

Kamihira	US 6,278,986 B1	Aug. 21, 2001

Steven d. Kaehler, *Fuzzy Logic - An Introduction*, http://www.seattlerobitics.org/encoder/mar98/fuz/fl_part1.html through ~/fl_part6.html, 04/28/2006 ("Kaehler").

The rejections

We restate the rejections as follows:

Claims 1-11 and 18-30 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Kaehler. As noted by Appellants (Br. 4, n.1), the Final Office Action (FOA) includes claims 13-16 in the § 102(b) rejection, but since these claims are dependent on independent claim 12, which is rejected under § 103(a), claims 13-16 cannot be anticipated. Since claims 13-16 are also rejected under § 103(a), we put claims 13-16 in the § 103(a) rejection. The FOA does not mention claim 30 in the statement of the rejection, but since it is discussed in the rejection, we include it here.

Claims 12-17 stand rejected under 35 U.S.C. § 103(a) as unpatentable over Kaehler and Kamihira.

ANTICIPATION

Contentions

Appellants argue as to independent claims 1, 7, 18, and 24 that while the data points representing temperature error and the time-derivative of the temperature error collectively "represent a curve," Kaehler's fuzzy logic is

used to describe the data points, not the curve represented by the data points. Br. 8-9. It is argued that Kaehler simply receives data points associated with an instant of time, either temperature error or the time-derivative of the temperature error, and matches each of the individual data points to the corresponding membership function to obtain a degree of memberships; Kaehler does not use fuzzy logic to describe a curve of temperature versus time. Br. 9-10.

The Examiner states that Kaehler discloses fuzzy logic to describe a curve represented by multiple data points. Ans. 8. The Examiner states that "just because the appellant draws a box on a flow chart (see e.g., appellant's Fig. 4A) that says 'curve match' does not mean a picture of a curve is drawn on a paper with a pencil and scanned into a computer." Ans. 9. The Examiner states:

> Looking at appellant's own disclosure (see paragraphs 0025 and 0026 below) it is more clear that computer programs use equations of lines, if-then statements, and/or algorithms that compare data points or values. The computer system disclosed by the appellant is not using real curves drawn on paper by humans or printers and performing image analysis to compare pictures of curves. Both the appellant and the applied art operate in the standard way of using equations, or algorithms to accept data points input from e.g., sensors and compare said data points to values associated in fuzzy membership functions and fuzzy curves.

Ans. 9.

The Examiner further states that "[i]f the data points represent the curve, it is to these points that fuzzy logic is applied," Ans. 10, and a computer necessarily operates on data points and not curves, *id.*

The Examiner further states that the fuzzy parameters of error and error-dot generate a curve as shown in Fig. 2 on page 3 of Part 3. Ans. 10.

Appellants argue that "the only thing *Kaehler's* fuzzy logic engine does is receive a *scalar value* and determine its membership in a fuzzy set. *Kaehler* does not disclose 'determining membership of said *input curve* in at least one Fuzzy Set', as recited in claim 30, because a scalar value is not an input curve." Br. 11.

The Examiner states that Kaehler discloses a membership function and "[t]he degree of membership will describe a property of the input data (the curve)." Ans. 12.

Issues

Issue 1: Does Kaehler describe "receiving curve data as an input, said curve data comprising a plurality of data points representing a curve, said curve matching mechanism using Fuzzy Logic to describe said curve represented by said curve data," as recited in claims 1, 7, and 18? Claim 24 contains corresponding method limitations.

Issue 2: Does Kaehler describe "receiving data representing an input curve as input; determining membership of said input curve in at least one Fuzzy Set, each said Fuzzy Set expressing a property of a respective at least one curve," as recited in claim 30?

Principles of law

"Anticipation requires the presence in a single prior art disclosure of all elements of a claimed invention arranged as in the claim." *Connell v. Sears, Roebuck & Co.*, 722 F.2d 1542, 1548 (Fed. Cir. 1983).

Findings of fact

Kaehler describes fuzzy logic (FL) and its application to control systems in a six-part article.

Fuzzy logic provides "a simple way to arrive at a definite conclusion based upon vague, ambiguous, imprecise, noisy, or missing input information." Part 1, p. 1. "FL can control nonlinear systems that would be difficult or impossible to model mathematically." Part 2, p. 2.

In a proportional temperature controller example, the inputs in Kaehler are a temperature error signal (computed from a temperature measurement and a command signal set-point, i.e., Cmd - Temp, just called "error") and a time-differentiated error signal representing the error slope or rate-of-change-of-error (called "temperature error dot" or "just error dot," i.e., d(Cmd - Temp)/dt). Part 1, p. 2; Part 3, p. 4. The inputs for each can be described as "N" (negative), "Z" (zero), or "P" (positive). The output of the system can be "H" (heat), "-" (no change), or "C" (cool). Part 3, p. 2.

Rules are set up to describe the control system, which have the format: "IF (Cmd-Temp)=W AND d(Cmd-Temp)/dt=X THEN Output=Z," where W and X are N or Z or P and Z is H or - or C. These rules can be represented in a rule matrix. Part 3, p. 4.

The inputs are compared to fuzzy membership functions to determine a degree of membership. For example, a temperature error of -1.0 corresponds to a degree of membership of 0.5 in the N (negative) and 0.5 in the Z (zero) functions and a temperature error-dot of 2.5 corresponds to a degree of membership of 0.5 in the Z (zero) and 0.5 in the P (positive) functions, which determine the firing strength of each rule. Figure 7, Part 5. Several methods exist to combine the various rules and the data is defuzzified to result in a crisp output. Part 6.

Analysis

Issue 1

A "curve" is a locus of points, e.g., a straight line is a locus of points whose coordinates satisfy a linear equation, $y = mx + b$, and a circle is with radius 1 is the locus of points which satisfy $x^2 + y^2 = 1$. The "Temp" curve in Figure 2, Part 3, p. 3 is an example of a curve, i.e., it is a locus of points for temperature versus time, where the ordinate axis represents the difference (error) between command setpoint (Cmd) and the temperature (Temp); there would also be a curve for error-dot. Appellants acknowledge that the data points representing error and error-dot collectively "represent a curve," but argue that Kaehler's fuzzy logic operates on individual data points, not the curve represented by the collection of data points. We agree. Kaehler determines the scalar values of error and error-dot at each sampling instant of time, and uses these to determine the degree of membership as shown in Figure 7, Part 5, p. 2, and ultimately to control the control system.

Kaehler does not consider the individual scalar values collectively as a curve and, so, does not teach a "curve matching mechanism using Fuzzy Logic to describe said curve represented by said curve data."

We do not exactly understand the Examiner's reasoning. The Examiner appears to say that a curve must actually be drawn and then compared using image analysis, which Appellants do not disclose, and that Appellants' disclosed system works in the same way as Kaehler by accepting data points from sensors and comparing them to membership functions. However, a curve does not have to be drawn in human viewable form--it can exist as a series of points (x, y) stored in the computer. Kaehler operates on individual scalar values for error (e) or error-dot (e-dot) at a certain time, and controls the system based only on those separate values. Appellants' invention operates on (at least) two-dimensional curve data, a time series of points, say (x_1, t_1), (x_2, t_2), . . ., (x_n, t_n), and uses fuzzy logic to describe the curve of x versus time. Appellants' invention relates to matching a curve, such as a curve of mass airflow (MAF) or oxygen (O_2) values versus time to another curve, such as curves that are monotonically increasing, monotonically decreasing, inflected up, inflected down, and flat as described at Specification ¶ [0024]. While Kaehler shows a curve at Figure 2, Part 3, p. 3, Kaehler does not try to match this curve to another curve using fuzzy logic, but matches values at certain times to fuzzy membership functions. While it is true that both Kaehler and Appellants' invention must operate on points inside the computer, there is a clear difference between operating on

individual scalar values in Kaehler and matching one curve to another using fuzzy logic as claimed.

Issue 2

Kaehler does not describe operating on "curve data" as discussed in the analysis of Issue 1. Accordingly, Kaehler does not describe "determining membership of said input curve in at least one Fuzzy Set, each said Fuzzy Set expressing a property of a respective at least one curve."

Conclusion

Issue 1: Kaehler does not describe "receiving curve data as an input, said curve data comprising a plurality of data points representing a curve, said curve matching mechanism using Fuzzy Logic to describe said curve represented by said curve data," as recited in claims 1, 7, and 18, and a corresponding limitation in claim 24. The rejection of claims 1-11 and 18-29 is reversed.

Issue 2: Kaehler does not describe "receiving data representing an input curve as input; determining membership of said input curve in at least one Fuzzy Set, each said Fuzzy Set expressing a property of a respective at least one curve," as recited in claim 30. The rejection of claim 30 is reversed.

OBVIOUSNESS

Issue

Claim 12 contains the same limitations addressed in the anticipation rejection of claims 1, 7, and 18. Claim 12 recites a fuzzy controller associated with an engine. The Examiner applies Kamihira to show a control system for a vehicle engine, which may use fuzzy logic. Appellants argue that Kamihira does not cure the deficiencies of Kaehler.

The issue is:

Does Kamihira cure the deficiencies of Kaehler with regard to the limitation of "receiving curve data as an input, said curve data comprising a plurality of data points representing a curve, said curve matching mechanism using Fuzzy Logic to describe said curve represented by said curve data"?

Principles of law

An obviousness rejection must account for all limitations in the claims. 35 U.S.C. § 103(a).

Findings of fact

Kamihira describes that fuzzy logic system might be used instead of, or in addition to neural networks for an adaptive feedback control system for a vehicle engine. Col. 16, ll. 1-16.

Kamihira does not describe in detail the fuzzy logic systems or fuzzy set membership and does not describe using fuzzy logic to describe a curve.

Analysis

The Examiner does not rely on Kamihira for a "curve matching mechanism using Fuzzy Logic to describe said curve represented by said curve data." We find that Kamihira does not describe using fuzzy logic for curve matching as recited in claim 12.

Conclusion

Kamihira does not cure the deficiencies of Kaehler with regard to the limitation of "receiving curve data as an input, said curve data comprising a plurality of data points representing a curve, said curve matching mechanism using Fuzzy Logic to describe said curve represented by said curve data." The rejection of claims 12-17 is reversed.

CONCLUSION

The rejection of claims 1-11 and 18-30 under 35 U.S.C. § 102(b) is reversed.

The rejection of claims 12-17 under 35 U.S.C. § 103(a) is reversed.

REVERSED

rwk

IBM CORPORATION
ROCHESTER IP LAW DEPT. 917
3605 HIGHWAY 52 NORTH
ROCHESTER, MN 55901-7829